FOOD INNOVATION ASIA CONFERECNE 2016

PROCEEDINGS

FOOD RESEARCH AND INNOVATION FOR SUSTAINABLE GLOBAL PROSPERITY

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Food Innovation Asia Conference 2016

Food Research and Innovation for Sustainable Global Prosperity

Contents

The 18th Food Innovation Asia Conference 2016 (FIAC 2016)

16–18 June 2016, BITEC Bangna, Bangkok, Thailand

About the Conference

The conference will provide opportunity to meet and share experiences as well as strengthen networking among international food scientists and scientists in related fields from academia, government and food industries. The objective is to highlight significant developments in research and innovations in food science and technology with an emphasis on Food Research and Innovation for Sustainable Global Prosperity. The conference will feature a series of presentations and discussions in plenary, concurrent and poster sessions, informal gatherings, competitions and exhibitions.

Division (A) Food Chemistry, Nutrition, and Analysis
Division (B) Food Processing and Engineering
Division (C) Food Product Development, Sensory, and Consumer Research
Division (D) Food Microbiology, Food Biotechnology, Fermentation
Division (E) Related Topics (Food Packaging, Food Safety & Quality, Food Laws & Regulations, Food Policy, etc.)
Division (F) Industrial session

Concurrent Events

- ProPak ASIA 2016
- FoSTAT - Nestlé Quiz Bowl 2016
- Food Innovation Contest 2016 (final round)
- STI for Agri-Food Industry Development Framework
- ACS Thailand section
- FIFSTA Annual meeting
- AIAC Annual meeting
- Thailand Section of AOAC International meeting

Organizers

- Food Science and Technology Association of Thailand (FoSTAT)
- Agro-Industry Academic Council Association (AIAC)
- Faculty of Agro-Industry , Chiang Mai University
- School of Agriculture Technology, Walailak University
- National Science Technology and Innovation Policy Office (STI)
- Thailand Section of AOAC International

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Contents of the Conference Proceedings

Session : Oral Presentation

Division A: Food Chemistry, Nutrition and Analysis

Division B: Food Processing and Engineering

Division C: Food Product Development, Sensory and Consumer Research

Session : Poster Presentation

Division A: Food Chemistry, Nutrition and Analysis

Substitution Effect of Mocaf (Modified Cassava Flour), Carrageenan and Seaweed on Properties of Analog Rice from Lesser Yam Tubers (*Dioscorea esculenta* L.)

Sri Winarti[1)], Enny Karti Basuki Susiloningsih[1)] and Ramdan Hidayat[2)]

[1]*Food Technology Program, Industrial Technology Faculty, University of Pembangunan Nasional "Veteran" Jawa Timur, Jl. Raya Rungkut Madya, Surabaya, Indonesia, 60294; Phone number: (031)8782179*
Corresponding author E-mail : swin_tpupn@yahoo.com

[2]*Faculty of Agriculture,, University of Pembangunan Nasional "Veteran" Jawa Timur, Jl. Raya Rungkut Madya, Surabaya, Indonesia, 60294*

ABSTRACT: Research on diversification of food product from lesser yam tubers (*Dioscorea esculenta* L.) into analog rice was performed. This study was the innovation of new products to enhance the benefits of local food sources. The purpose of this study was to obtain the best formula of analog rice from lesser yam tubers, mocaf (modified cassava flour), carrageenan and seaweed. This research was conducted in two stages, the first stage was the making of lesser yam and mocaf flour. Making of mocaf carried out by fermentation using *Lactobacillus plantarum* FNCC 0027. The 2nd stage was the addition carrageenan or seaweed on the formulation of analog rice. The data from this research analysis using ANOVA (analysis of variant) and DMRT (duncan't multiple range teste). The results showed that the average yield of lesser yam flour 16.24%, mocaf flour 23.32% (fermentation 1 day); 23.23% (fermentation 2 days) and 22.73% (fermentation 3 days). The results of the studied known that the addition of 2% carrageenan in analog rice preferably consumers compared with addition of seaweed 2%. The analog rice with addition 2% carrageenan have characteristics: the levels of dietary fiber 14.28%; rehydration power 51.00% and expansión volume 136.67%, the value of consumer preferences to the taste of cooked rice was 3.67; texture 3.83; and smell 3.83. Sensory method used in research was hedonic scale scoring, with range value 1-5. 1 = not preference and 5= very preference by consumer.
Keywords: analog rice, lesser yam, carrageenan, seaweed, *Dioscorea esculenta* L.

INTRODUCTION

Food and nutrition is one of the determinants of increased productivity and national competitiveness in the global arena. Supply, distribution and consumption of food with the amount, security and adequate nutritional quality must be guaranteed. Diet and desires of the community in various area in Indonesia so diverse that need explore the potential of local food in each region so that people healthy and active life.

Indonesia is very rich variety of local food that is already exist and entrenched in society. Local food has a strategic role and it is tremendous potential, but currently there is a tendency for people ignoring local food sources and prefers imported food. The younger generation may be even don't know more local food in the area. The local food contains a lot of health benefits that are not less than imported food and has a strategic role as well as many benefits for health.

Despite of the many benefits, unfortunately, people still seem less appreciate and realize the importance of developing local food seriously. As a result, people become accustomed with food imports. Base on regulation and food diversification of local resources, the Government of Indonesia hope that level of food consumption patterns must be diverse, nutritionally balanced, lawful and safe. Its needs strengthening and the participation of local governments in the development and implementation food diversification program based on local resources. One type of local tubers that need to be improved and empowered role is lesser yam tuber (*Dioscorea esculenta* L.).

Lesser yam is one kind of plant that grows in many parts of Indonesia, growing wild in the garden residents and in the forests. The tubers from this plant normally were used by community as source of carbohydrate alternative. Until now it is use still very limited.

The lesser yam plant advantages compared to other plants that can be grown on non-irrigated land, degraded land, without intensive farming and as intercrops (Gsianturi, 2003), the tubers contain inulin which has activity as a prebiotic (Winarti, *et al*., 2011). Prebiotics are food components that can't be digested in the upper gastrointestinal tract, and can stimulate the selective growth and activity of beneficial bacteria in the digestive tract, such as bifidobacteria and lactobacilli, so as to improve the health of the host (Gibson, 2004; Pompei *et al*., 2008; Gaggia *et al*., 2010).

Development of analog rice from lesser yam tubers is one effort to new innovation to make beneficial of local food source that is relatively abundant in Indonesia, and providing alternative food that is cheap and nutritious, so it can be beneficial to strengthening food self-sufficiency.

Analog rice is rice the result from innovations base on lesser yam flour, made in the form of granules look like with the rice. There are two methods for making the analog rice. Analog rice produced by granulation technology has a hard texture and appearance beyond rude so less preferred by consumers. Therefore, we developed analog rice by extrusion technology. This analog rice has better quality and more preferred by consumers.

Extrusion is a process where materials imposed by the force of the screw to flow in a narrow room that will undergo mixing and cooking as well. The main heat source the extrusion process from the conversion of mechanical (friction) is due to friction between the material and friction between materials with a screw. Work the thread also results in an accumulation of pressure in the extruder barrel, the material is forced out through the mold (die) that is small in size and return to normal pressure (atmospheric) instantaneously ie when the product through the die (Budi, *et al*., 2013).

Previous research that has been done was development prebiotic and synbiotic food product based on lesser yam tuber (Winarti and Saputro, 2013) and the extraction of inulin from the *Dioscorea* spp. tubers as prebiotic component (Winarti *et al*, 2011). But making analog rice has never been done from lesser yam tubers. Therefore it is necessary to do research on the innovation to making analog rice, the sensory test to know consumer preferences about analog rice from lesser yam tubers.

The research objective was to determine the effect of substitution mocaf flour (modified cassava flour), carrageenan and seaweed to quality and consumer preference analog rice from lesser yam tubers.

MATERIAL AND METHODS

Materials: lesser yam tubers (*Dioscorea esculenta* L.) were obtained from the

Nganjuk region, East Java. Supporting materials include mocaf, corn starch, carrageenan and seaweed.

Material for analysis including alpha-amylase enzyme, phosphate buffer, pepsin enzyme, beta-amylase enzyme, ethanol, acetone and destilation water.

The equipment used in this research includes cabinet dryers, single screw extruder, disk mill, plastic strapping, vacuum sealer, soaking tub, strainers, cans and plastic tools.

Method: Stage 1, a) Preparation of lesser yam flour, b) Preparation of mocaf flour by fermentation using *Lactobacillus plantarum* FNCC 0027. Stage 2: Formulation analog rice, the best formulation from previous research (mocaf flour 15% and lesser yam flour 85%), mixed with seaweed or carrageenan at concentrations of 0%,1% and 2%. Coupled with other ingredients that are GMS (Glycerol Mono Stearate), skim milk, vegetable oil, and water then mixed until homogeneous. The flour mixture/dough was formed with an single extruder (length 1.8 m, with diameter die 2mm) at a temperature of 100ºC to form granules of rice called analog rice. Analog rice then dried at 60°C, for 24 hours.

Hedonic scale scoring test was used to evaluation of sensory quality of cooked analog rice with 20 consumers. Range value in this test 1 until 5, 1= not preference and 5= very preference by consumer.

RESULT AND DISCUSSION

Characteristics of lesser yam flour which used as raw material for making analog rice were presented in Table 1.

Starch content is one of the criteria for the quality of flour, both as food and non-food. Amylopectin content of the material is closely related to adhesion properties of these materials. The higher levels of amylopectin in rice cause the cook rice more closely/sticky. Starch tubers that have high amylopectin content also form the gel stickier compared with low amylopectin when starch is heated.

Table 1 Characteristics of lesser yam flour

Component	Content (%)
Yield of powder	16.24 ± 0.238
Water	5.04 ± 0.059
Ash	0.99 ± 0.026
Starch	82.82 ± 0.14
Amylose	13.26 ± 0.08
Amylopectin	69.56 ± 0.12
Dietary fiber	10.77±0.03

Note: the average value of three replicates

MOCAF (Modified Cassava Flour) is a derivate product from cassava flour that uses the principle of modified cassava cells by lactic acid bacteria during fermentation (Subagio, 2007; Haryadi, 2011). The lactic acid bacteria used in this study was *Lactobacillus plantarum* FNCC 0047 obtained from the Center of Food and Nutrition Studies, Universitas Gadjah Mada, Yogyakarta. Characteristics of mocaf with different fermentation time were presented in Table 2.

Table 2 Characteristics of mocaf with different fermentation time.

Fermentation time (day)	Yield (%)	Water content (%)	Ash content (%)
0	23.03±0.12	4.82±0.01	1.02±0.04
1	23.32±0.14	4.90±0.00	0.99±0.01
2	23.23±0.09	4.84±0.01	0.82±0.00
3	22.73±0.08	4.73±0.02	0.76±0.00

Note: the average value of three replicates

Increasing fermentation time can reduce the yield, moisture and ash content in mocaf. That is due that the microbes were grow on cassava produce pectinolytic and cellulolytic enzymes that can destroy the cell walls of cassava such that happen destruction/perforation of the starch granules. The microbes also produce enzymes that hydrolyze starch into sugars and then convert it into organic acids, especially lactic acid. The longer of fermentation time, starch granules are broken more so that simplify the process of evaporation of water during the drying mocaf, so the water levels began to decline. Decline of water levels in mocaf cause reduced the yield by weight.

During fermentation there are components of cassava soluble in water and occurs destruction of cellulose in cassava becomes soft texture and perforation on starch granules wall (Umar, 2013). The longer of fermentation time will be more cellulose wall ruptured, it is due the water content easier for evaporated, and declined the yield of mocaf.

The results of the analysis of starch granules mocaf using electron scanning microscope can be seen in Figure 1. The longer of fermentation time, the starch granules were damaged/broken more (indicated by arrows in Figure 1). This is due the microbes that grow on cassava will produce pectinolytic and cellulolytic enzymes that can destroy the cell walls of cassava granules. The microbes also produce enzymes that hydrolyze starch into sugars and then convert it into organic acids, especially lactic acid. This process will lead to changes in characteristics of the cassava flour include increasing the viscosity, gelation capability, rehydration power, and enhanced the solubility. Furthermore, the starch granules will hydrolysis to produce monosaccharide as raw material to produce organic acids. Compounds of this acid mixes with cassava flour cause produce sense and specific flavor that can mask the natural sense and flavor of cassava which not preferred by consumers. The flavor of mocaf become neutral to cover up the flavor of cassava to 70% (Subagio, 2007).

During fermentation can remove the color components such as pigments (especially the yellow cassava) and proteins that can cause a brown color when heating. The impact of removing the color components was the mocaf whiter than the usual color of cassava flour and also smelled neutral (no musty smell typical). This process will produce flour that almost resembles the characteristics and quality of wheat flour, so that the product is suitable for replacing wheat flour for food industry.

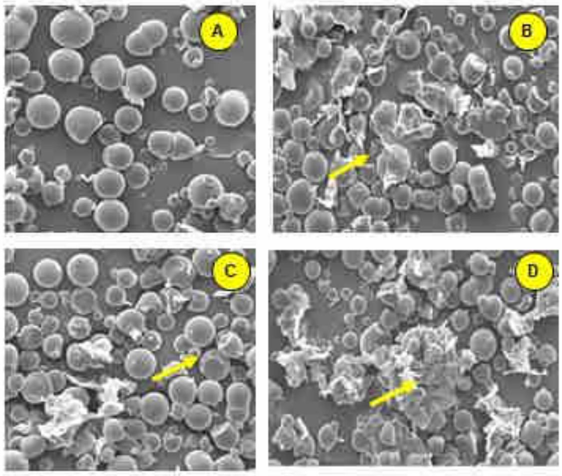

Figure 1 SEM (scaning electron microscope) of mocaf (A) Fermentation time 0 day; (B) 1 day; (C) 2 days; (D) 3 days.

Dietary Fiber of Analog Rice

The results showed that the higher addition of carrageenan or seaweed increase content of dietary fiber in the analog rice. This is because the main components of seaweed and carrageenan are soluble dietary fiber. Total dietary fiber is the total soluble fiber plus the total insoluble fiber (Marsono, 2002).

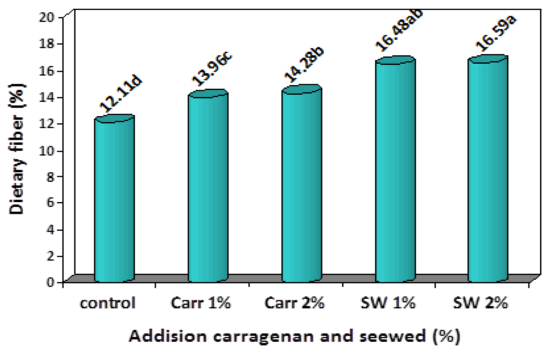

Figure 2 Total dietary fiber in analog rice

Note: different letters following the values in each histogram indicates significantly different

Rehydration Power

Rehydration power/water absorption of analog rice determined to know the ability of the rice to absorb water back when rice cooked. Water absorption can also be used to predict the shelf life of analog rice and appropriate packaging methods. Water absorption is influenced by several things, among others, long-chain, the number of polar groups or hydroxyl groups, the surface area of powder and water content (Hariyadi, 2011).

The results study showed that the higher addition of carrageenan/seaweed increased the rehydration power (Figure 3). Because carrageenan is a hydrocolloid compound that can form three-dimensional network when heated, so as to absorb and trap water well.

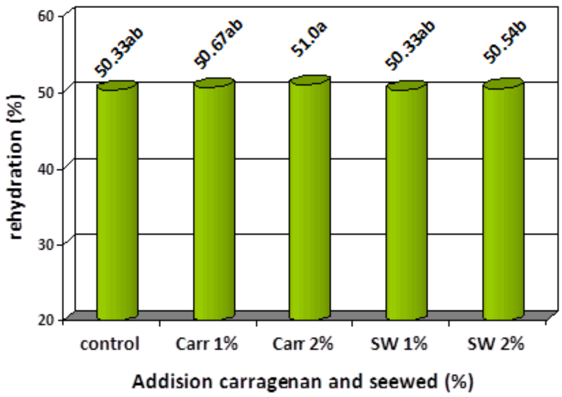

Figure 3 Rehydration power of analog rice.
Note: different letters following the values in each histogram indicates significantly different

Expansion Volume

The expansion volume of analog rice is the ability of rice to swell after steaming. Expansion volume has an important role to the quality of analog rice. The mechanism of expansion analog rice happened because rice absorbs the water through process of gelatinization of starch, starch properties can trap water to form a three-dimensional network.

The results from this research show that addition of carrageenan and seaweed can increase the expansion volume of the analog rice (Figure 4). This is because the carrageenan and seaweed is a hydrocolloid compound that can trap high water when heated.

Sensory Quality

The quality of food can be assessed in three ways: chemical, physical and sensory. Accepted or not the food products by consumers is determined by the quality factor especially sensory quality. Sensory properties are the nature of the starting materials by using human senses, namely the senses of sight, smell and taste.

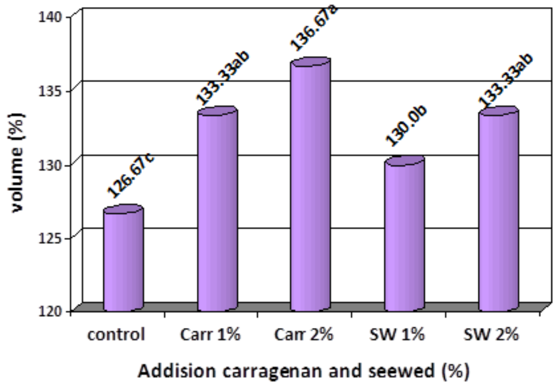

Figure 4 Expansion volume of analog rice.
Note: different letters following the values in each histogram indicates significantly different

The results showed that the highest score of consumer preference of taste, texture and color analog rice from lesser yam was the analog rice with addition carrageenan 2% (Table 3).

Table 3 The average of consumer preferred

Treatment	Teste	Texture	Colour
F0 (control)	3.00^{ab}	3.00^{b}	2.00^{ab}
Carragenan 1%	2.27^{c}	1.733^{c}	2.47^{b}
Carragenan 2%	3.40^{a}	3.89^{a}	3.80^{a}
Seaweed 1%	2.87^{b}	2.33^{bc}	2.53^{b}
Seaweed 2%	3.00^{ab}	2.53^{bc}	2.27^{b}

Note: different letters following the values indicates significantly different

Addition carrageenan 2% can increase chewy texture and fluffier than the addition of seaweed 2%. The addition of 2% carrageenan also provide color whiter than seaweed 2%, so it is more preferred by consumers. Addition seaweed is tends to give texture sticky and wet. Analog rice from lesser yam tubers addition with seaweed or carrageenan presented in Figure 5A and 5B.

Figure 5 Analog Rice from Lesser Yam Tubers, (A) Addition with seaweed, (B) Addition with carrageenan

CONCLUSIONS

The results of research indicated that the average of yield lesser yam flour 16.24%, mocaf flour 23.32% (fermentation 1 day); 23.23% (fermentation 2 days) and 22.73% (fermentation 3 days). The analog rice with addition 2% carrageenan have characteristics: the levels of dietary fiber 14.28%; rehydration power 51.00% and expansion volume 136.67%, the value of consumer preferences to the taste of cooked rice was 3.67; texture 3.83; and smell 3.83. Addition of carrageenan 2% in analog rice, preferably consumers compared with the addition of seaweed 2%.

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